(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 44501 Roll No. | | | | | | | | | | |

B.Tech.

(SEM. I) ODD SEMESTER THEORY EXAMINATION 2012-13

ENGINEERING MECHANICS

Time : 3 Hours *Total Marks : 100*

Note : *(1) This paper is in 3 sections. Section **A** carries **20** marks. Section **B** carries **30** marks and Section **C** carries **50** marks.*

*(2) Attempt **all** the questions. Marks are indicated against each question part.*

(3) Assume missing data suitably, if any.

SECTION—A

1. Answer **all** the parts :— **(10×2=20)**

(a) Two forces P and Q are inclined at angle of 75°. Magnitude of their resultant is 100 N. The angle between the resultant and P is 45°. Determine the magnitude of P.

(b) A body A is about to slip over body B. Normal reaction at the contact surface is 70 N and the angle of friction is 25°. Determine the total reaction of the surface.

(c) A joint of truss is connected by 3 members. No external force acts at the joint. Two of the members are collinear and third is inclined to them. Determine the relation between the forces in the members which are collinear.

(d) A uniform rod of length 20 cm is bent at an angle of 90° from the middle. Find the distance of C.G. of the rod from its middle point about which the rod is bent.

(e) A uniform rod of length 3 m and mass 15 kg is rotating about a vertical axis and one end of the rod is on the axis. Rod is rotating in horizontal plane. Determine the force at the fixed end of rod due to axis.

(f) Young's modulus and Bulk modulus of steel are $2{\cdot}1\times10^{11}$ Pa and $8{\cdot}4\times10^{10}$ Pa respectively. Determine the value of Poisson's ratio.

(g) A uniform beam is subjected to a couple of 20 Nm. The moment of inertia of the section of the beam about Neutral axis is $3{\cdot}54\times10^{4}$ cm^4. Radius of curvature of the beam is 50 m. Determine Young's modulus of material of the beam.

(h) A solid uniform rod of 2 m length is hanging vertically from the roof. The stress at a section 0·5 m away from the roof is 600 Pa. Determine the stress at a section of the rod at a distance of 1·5 m from the roof.

(i) A uniform disc of mass 10 kg and radius 40 cm is rolling on horizontal plane. The speed of the centre of mass is 50 cm/s. Determine the kinetic energy of the disc.

(j) Bending stress in a beam cross section at a distance of 15 cm from neutral axis is 50 MPa. Determine the magnitude of bending stress at a distance of 10 cm from neutral axis.

SECTION—B

2. Attempt any **three** of the following :— **(3×10=30)**

(a) A sphere of radius 20 cm and mass 20 kg is resting on a vertical smooth wall with the help of a chain of length 30 cm tied to wall as shown in Fig. 1. Determine the reaction of the wall and Tension in the chain.

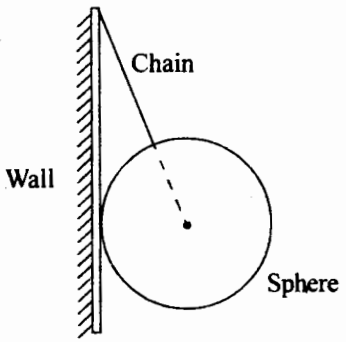

Fig. 1

(b) Determine the principal moment of inertia of the area shown in Fig. 2 for axes through origin.

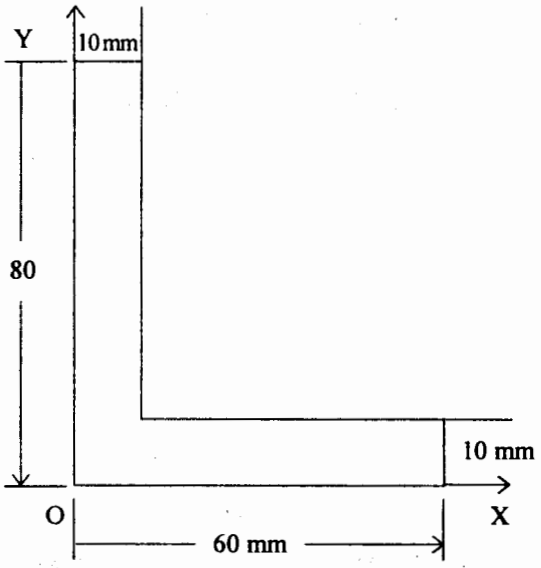

Fig. 2

(c) Determine the expression for shear force and bending moment for the beam shown in Fig. 3.

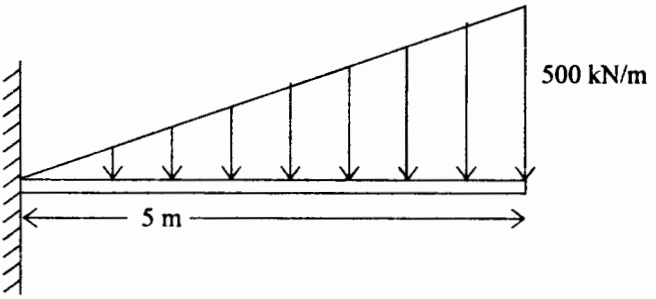

Fig. 3

(d) A tapered rod is shown in Fig. 4. Young's modulus of the material of the rod is 200 GPa. Find the deformation and strain energy stored in the rod.

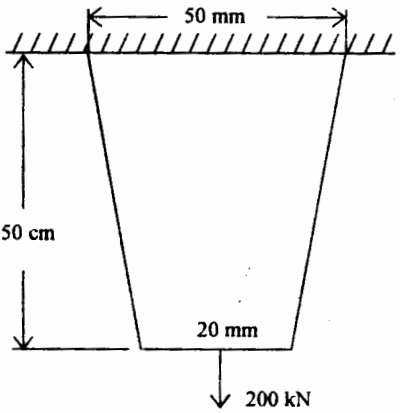

Fig. 4

(e) A particle of mass 5 kg is fixed at the periphery of a solid disc of radius 20 cm as shown in Fig. 5. The disc is rotating about an axis passing through its centre. Mass of the disc is 3 kg. At certain instant the angular velocity and acceleration of the disc are 10 rad/s and 5 rad/s^2 respectively. Calculate the torque on the axis of rotation and Kinetic energy of the system at the said instant.

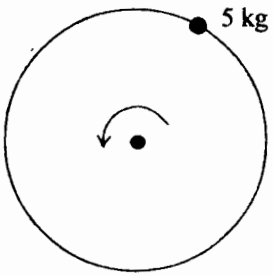

Fig. 5

SECTION—C

3. Attempt any **two** of the following :— **(2×5=10)**

(a) Two identical rollers each of weight 5000 N rest on smooth inclined planes as shown in Fig. 6. Find the Reactions of the planes on rollers.

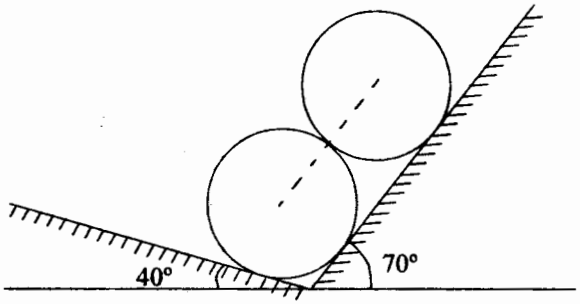

Fig. 6

(b) Determine the value of the force F needed to get the block just started up the incline as shown in Fig. 7. The coefficient of friction is 0·3. The weight of the block is 500 N.

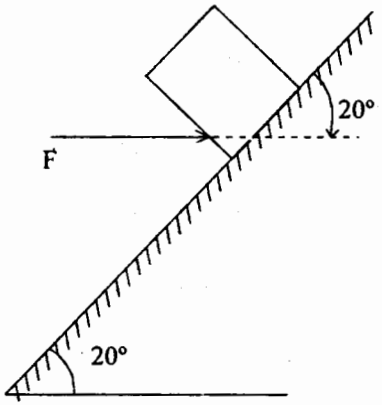

Fig. 7

(c) A 7 m long ladder is pushed by a horizontal force F as shown in Fig. 8. Determine the minimum value of F

necessary to move the ladder forward. The static coefficient of friction is 0·4 for all contact surfaces.

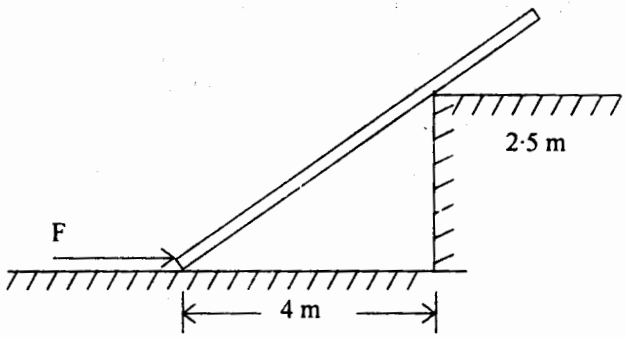

Fig. 8

4. Attempt any **one** of the following :— **(10×1=10)**

(a) Draw the S.F. diagram and B.M. diagram for the beam shown in Fig. 9.

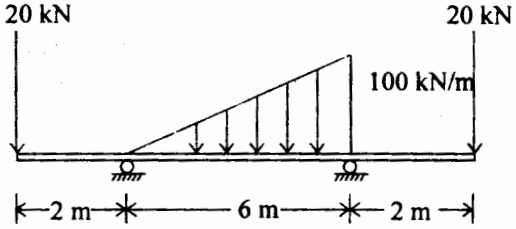

Fig. 9

(b) Determine forces in all the members of truss shown below in Fig. 10. All the horizontal members are 3 m long and vertical members 2 m long.

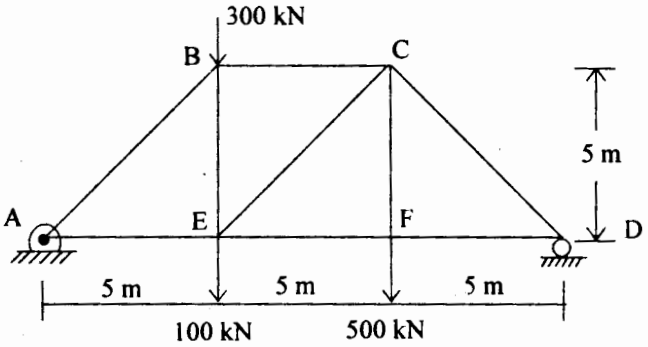

Fig. 10

5. Attempt any **two** of the following :— **(5×2=10)**

(a) Find the centroid of the area under half sine curve shown in Fig. 11. Find the centroid of this area about axis A—A'.

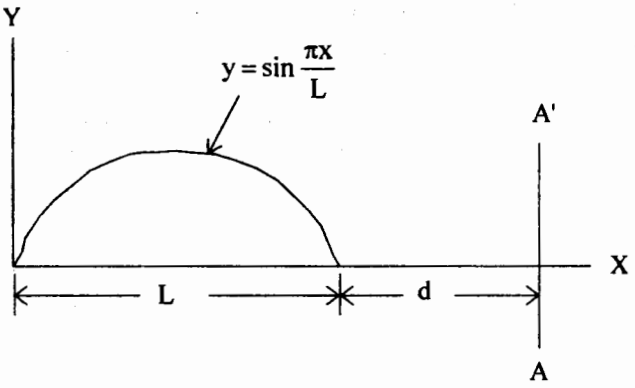

Fig. 11

(b) Compute the mass moment of inertia of right circular cone of radius r and height h about an axis passing through apex and normal to its base.

(c) Where must a lifting hook be placed in a tapered beam shown in Fig. 12, so that the beam always stays horizontal when lifted ?

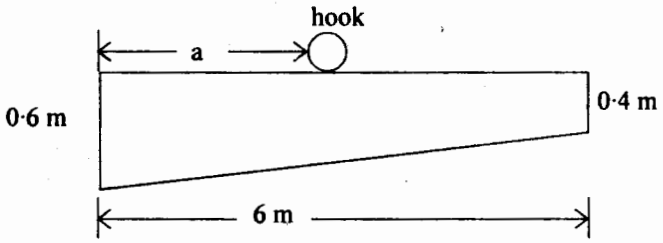

Fig. 12

6. Attempt any **one** of the following :— **(10×1=10)**

(a) A particle moves along a path $y = 3x^2$ m. The motion starts at t = 0 from origin and projection of the particle on x axis varies as $0{\cdot}4\ t^2$. What are the acceleration components in tangential direction and normal to the path at t = 2s ? What is the velocity of the particle at t = 2s ?

(b) A cylinder is rotating at a speed of 1800 rpm when a hand brake system applies a force of 350 N as shown in Fig. 13. The radius of gyration of the cylinder is 200 mm and mass is 500 kg. The dynamic coefficient of friction between the belt and cylinder is 0·4. How much time is required for cylinder to stop ?

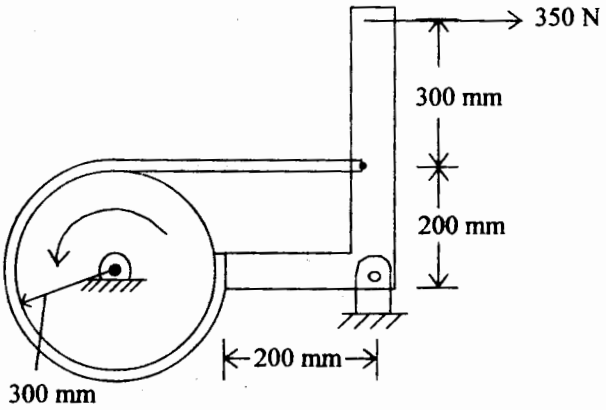

Fig. 13

7. Attempt any **one** of the following :— **(10×1=10)**

(a) A rectangular section beam of length 6 m is simply supported at its ends. Section of the beam is 60 mm wide and 150 mm deep. Beam carries a concentrated force of 15 kN in downward direction at a distance of 2 m from one support. Find the maximum bending stress in the beam.

(b) A circular shaft of 100 mm diameter transmits a power of 70 kW at 150 rpm. Find the value of maximum shear stress in the shaft and angle of twist per meter. Modulus of rigidity of the shaft material is 60 GPa.